

“Review of Stressors on the Delta Ecosystem”

Title of IEP Lead Scientist Talk to NRC, 12/8/2010

Interagency Ecological Program 2010 Pelagic Organism Decline Work Plan and Synthesis of Results

Prepared by: Randall Baxter (DFG), Rich Breuer (DWR), Larry Brown (USGS), Louise Conrad (DWR), Fred Feyrer (USBR), Stephanie Fong (CVRWQCB), Karen Gehrts (DWR), Lenny Grimaldo (USBR), Bruce Herbold (USEPA), Peter Hrodey (USFWS), Anke Mueller-Solger (DSC), Ted Sommer (DWR), and Kelly Souza (DFG)

6 December 2010

www.water.ca.gov/iep/

- The Interagency Ecological Program at 40 – *“Bay-Delta Science Family”*
- Drivers of Change in the 2010 POD Report – *“Three Stories about Drivers/Stressors”*

Good Drivers



... Gone Bad

- The Interagency Ecological Program at 40 – *“Bay-Delta Science Family”*
- Drivers of Change in the 2010 POD Report – *“Three Stories about Drivers/Stressors”*
- Lessons for Ecosystem Management and the Delta Plan

But first...
An experiment

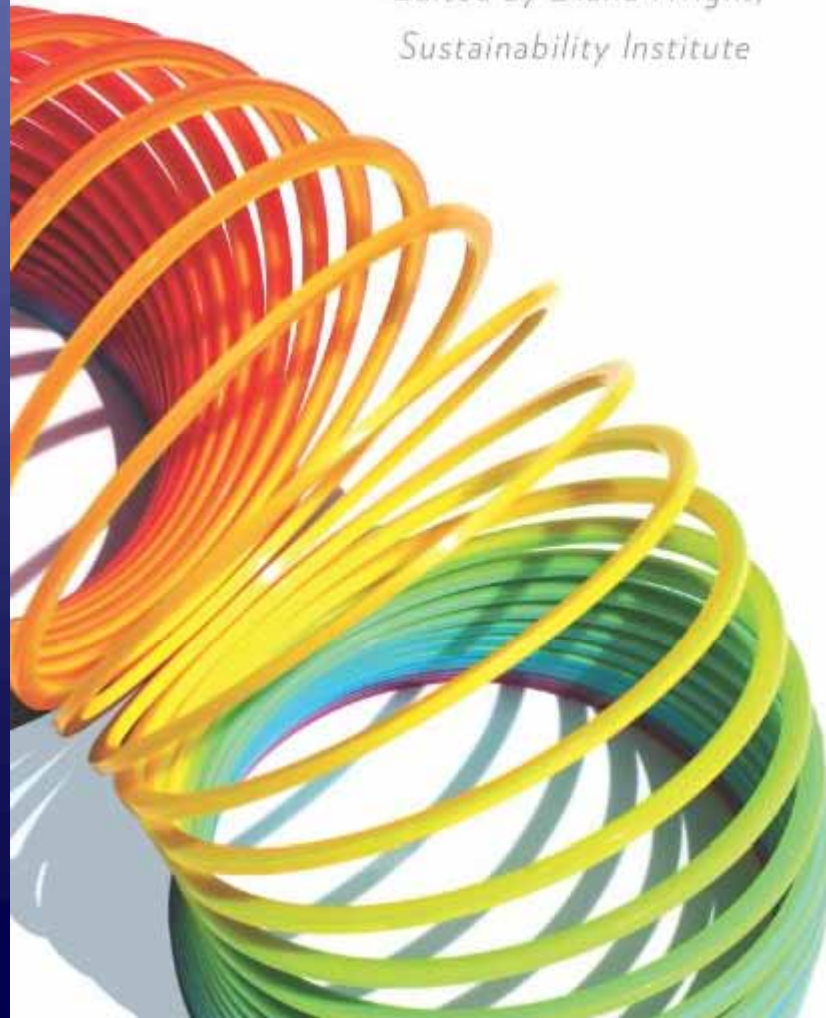
2008
Chelsea Green Publishing

Thinking in Systems

A Primer

Donella H. Meadows

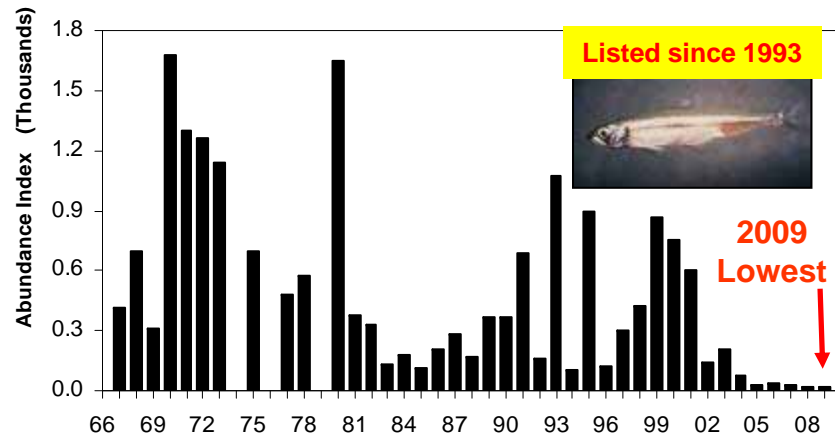
*Edited by Diana Wright,
Sustainability Institute*



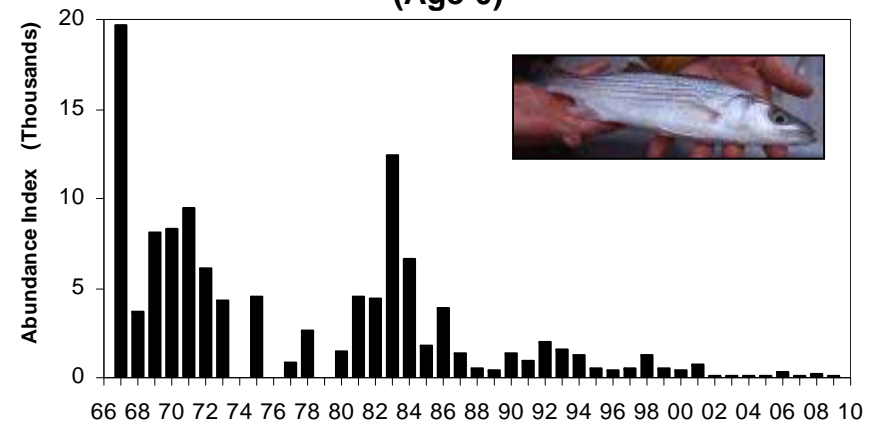
Long-term IEP Monitoring Shows Fish Declines

“Pelagic Organism Decline” (POD) Investigation since 2005

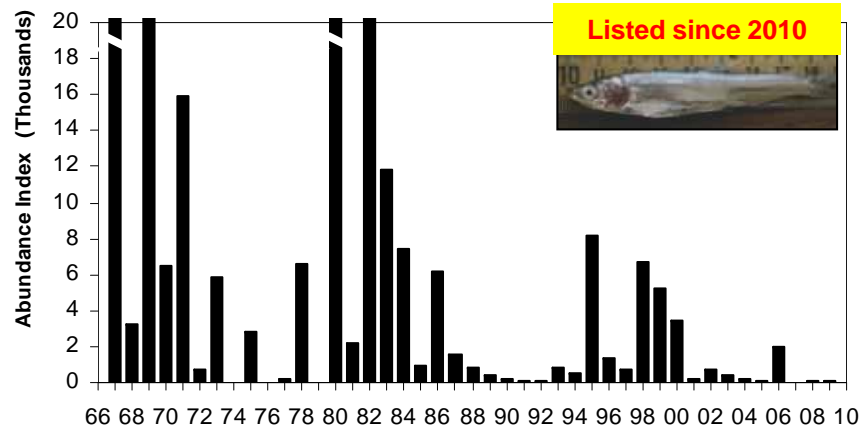
Delta Smelt



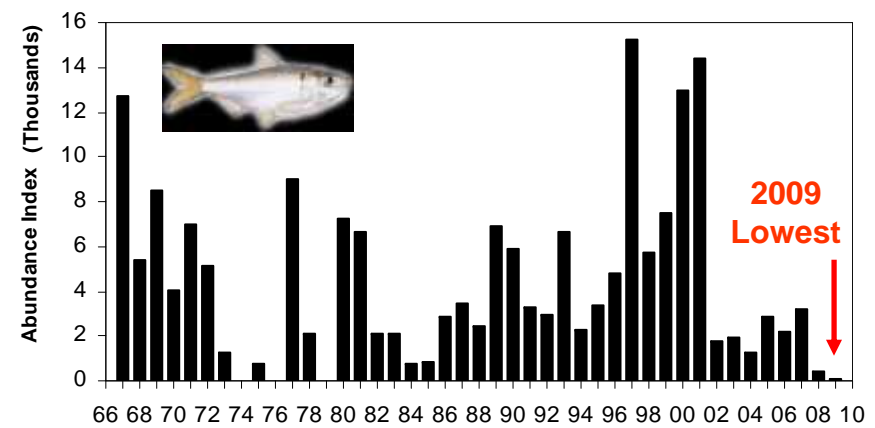
**Striped Bass
(Age-0)**



Longfin Smelt



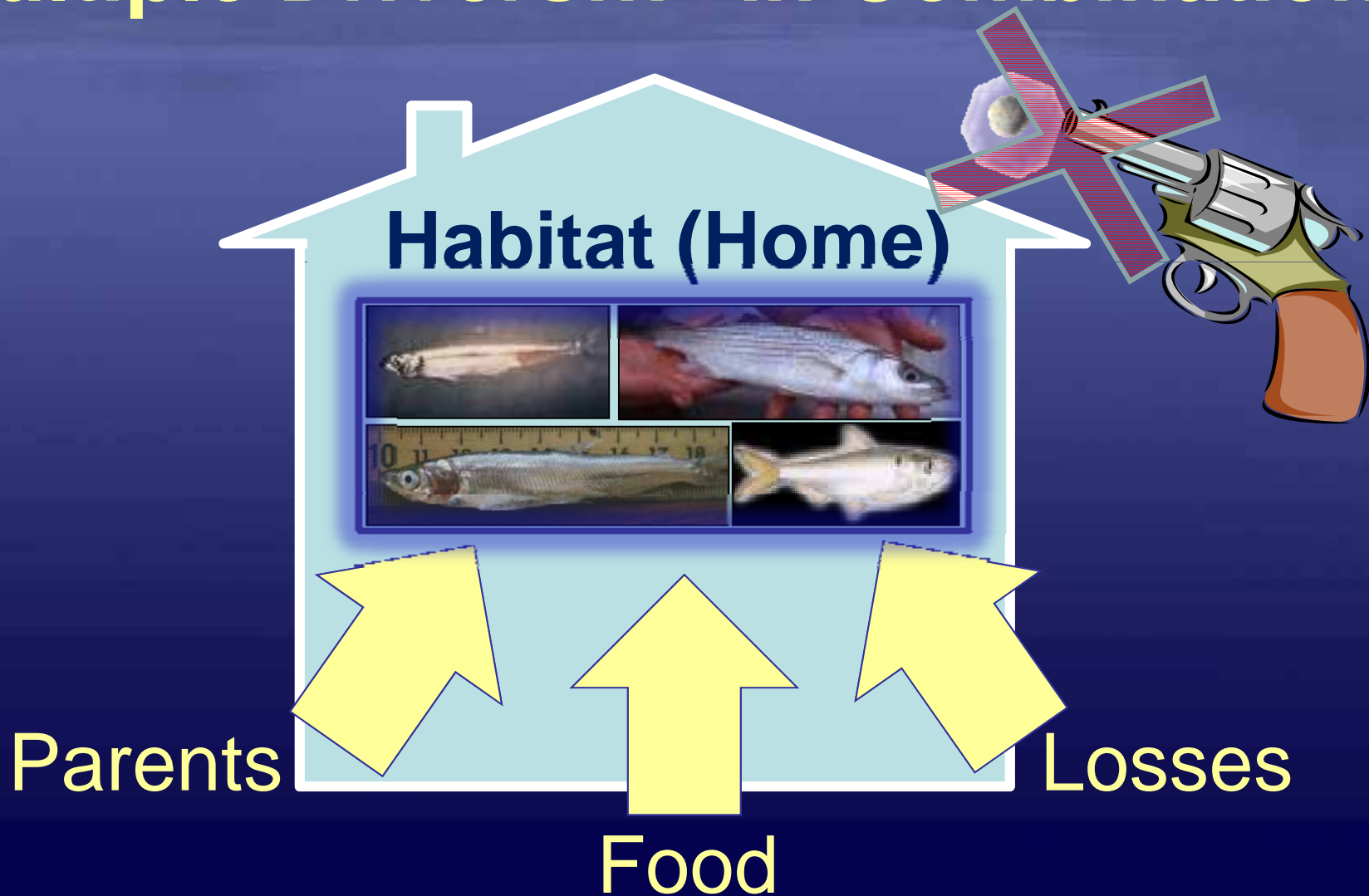
Threadfin Shad



Source DFG 2009 Fall MW Trawl - No indices in 1974, 1976 and 1979

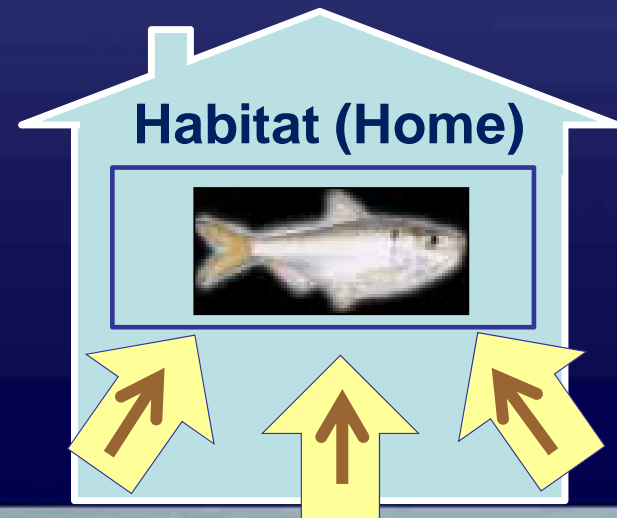
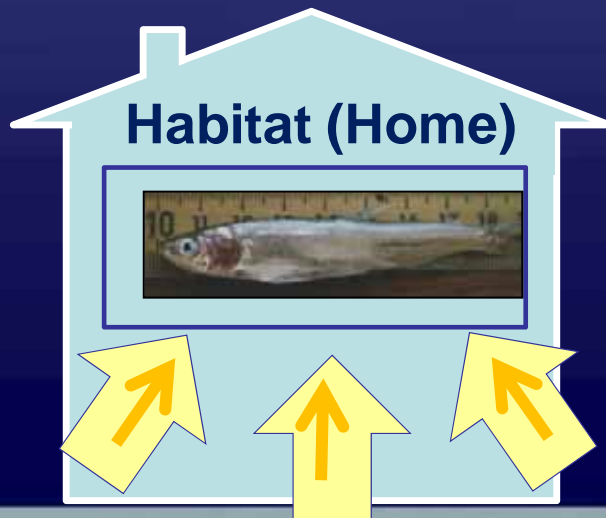
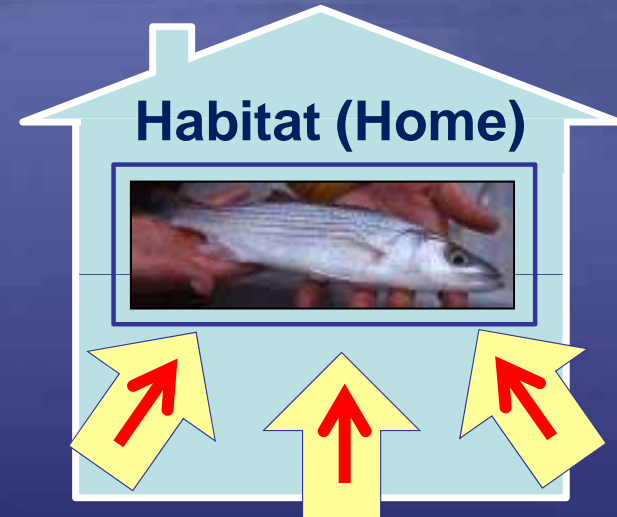
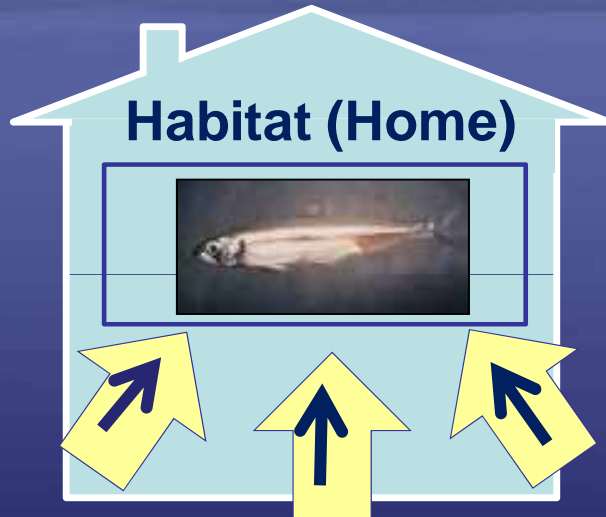
1. “Basic Ecology Story”

Multiple Drivers... in Combination



2. “Fish Stories”

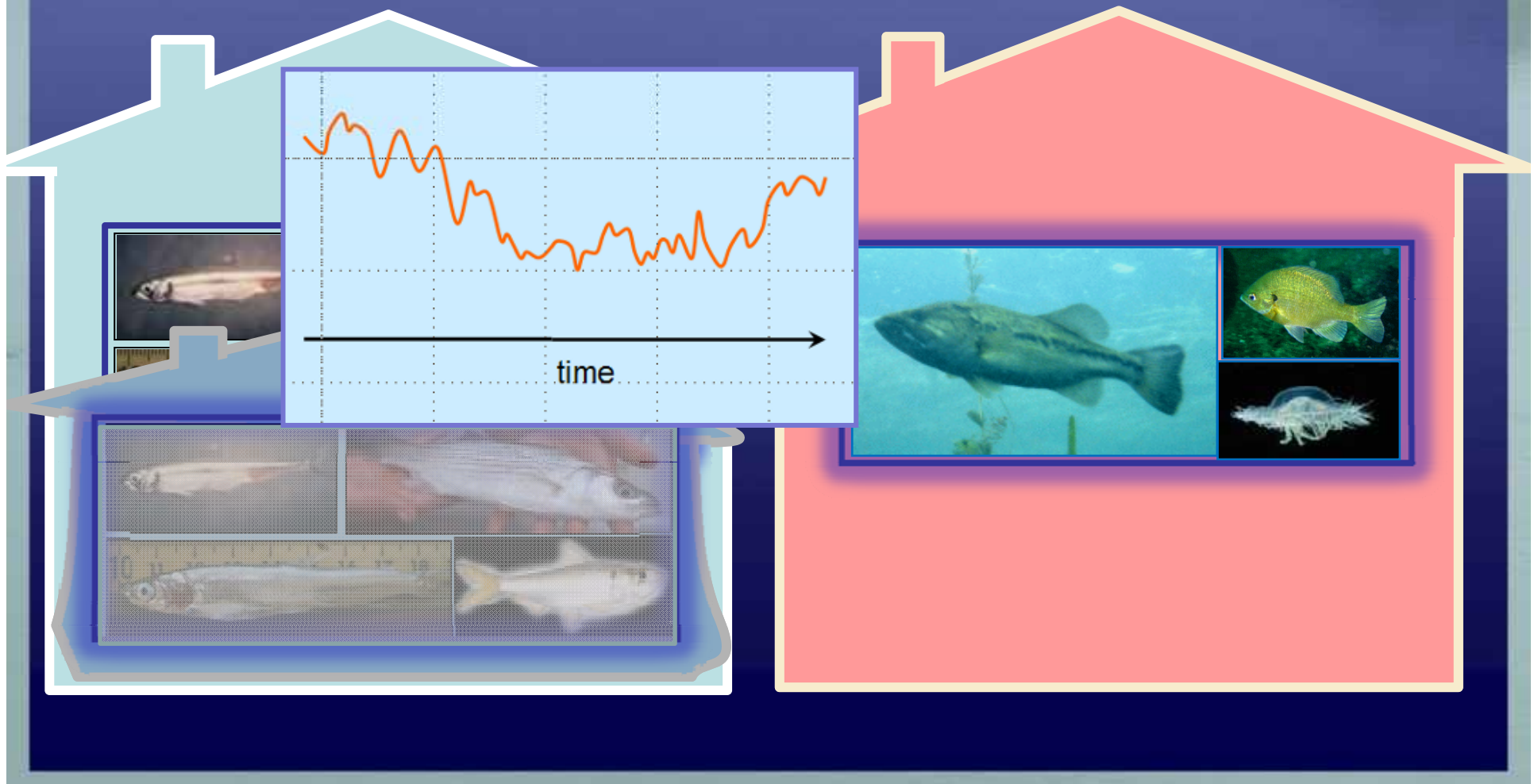
Different Fish... Different Responses



3. “Regime Shift Story”

Loss of Ecological Resilience

Old Regime Collapses, New Regime

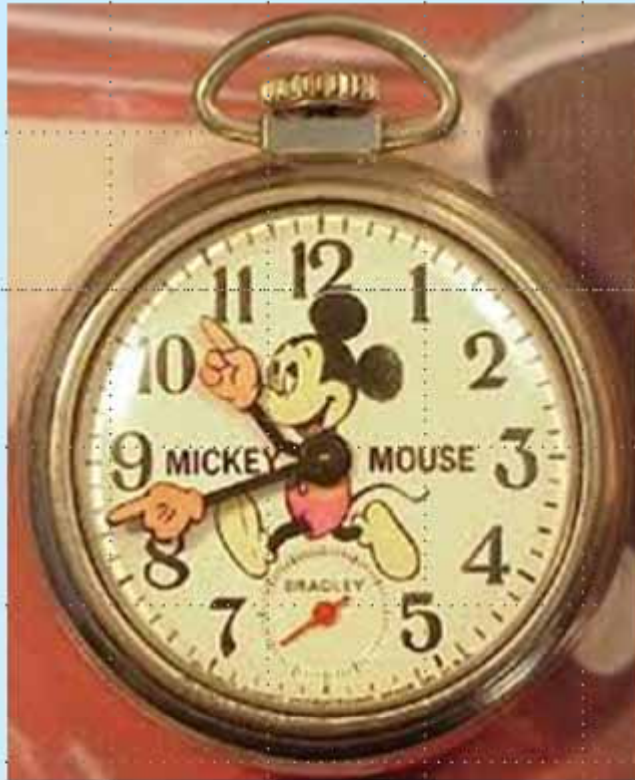


Historical Changes

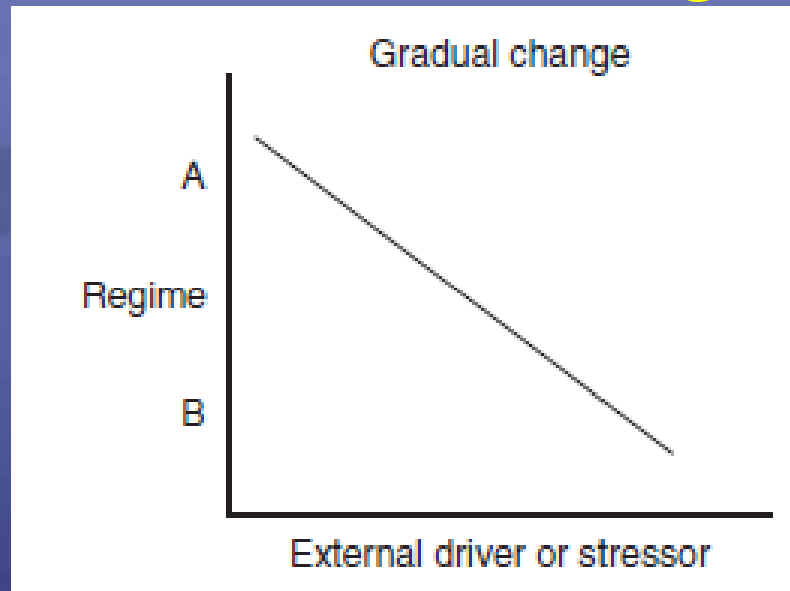
PRBO Conservation Science

John Wiens, 9/27/2010

Time may be Linear, but History is Not

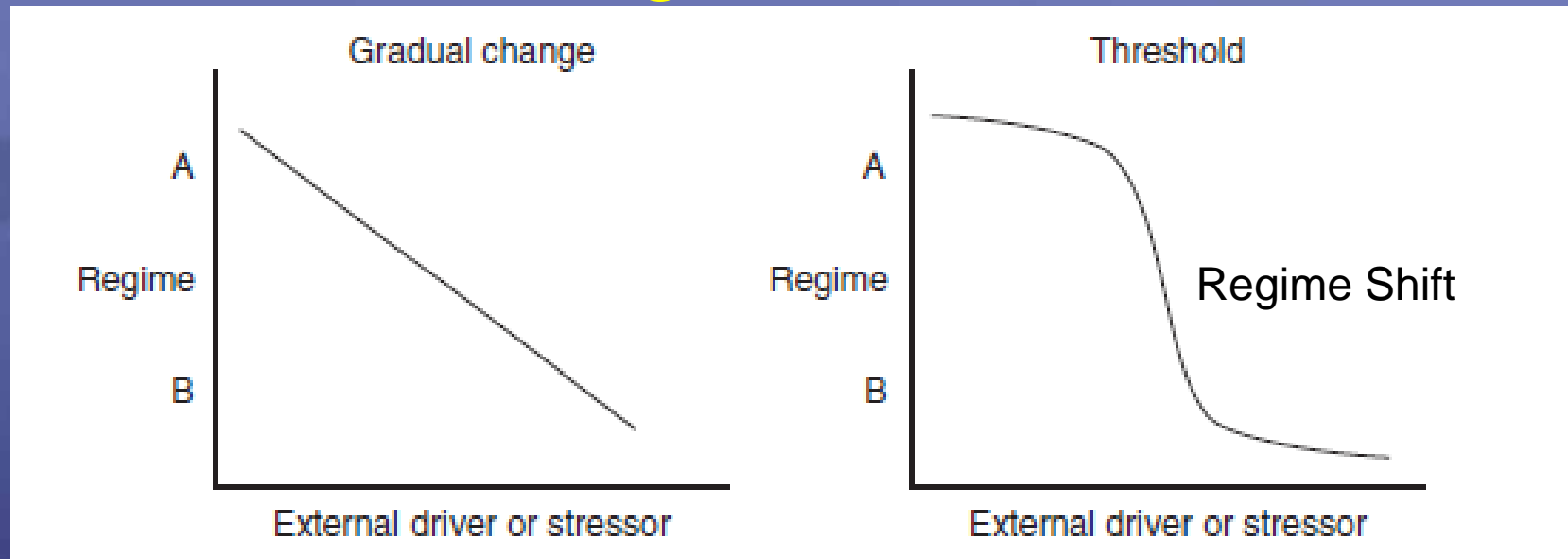


Changes in Drivers



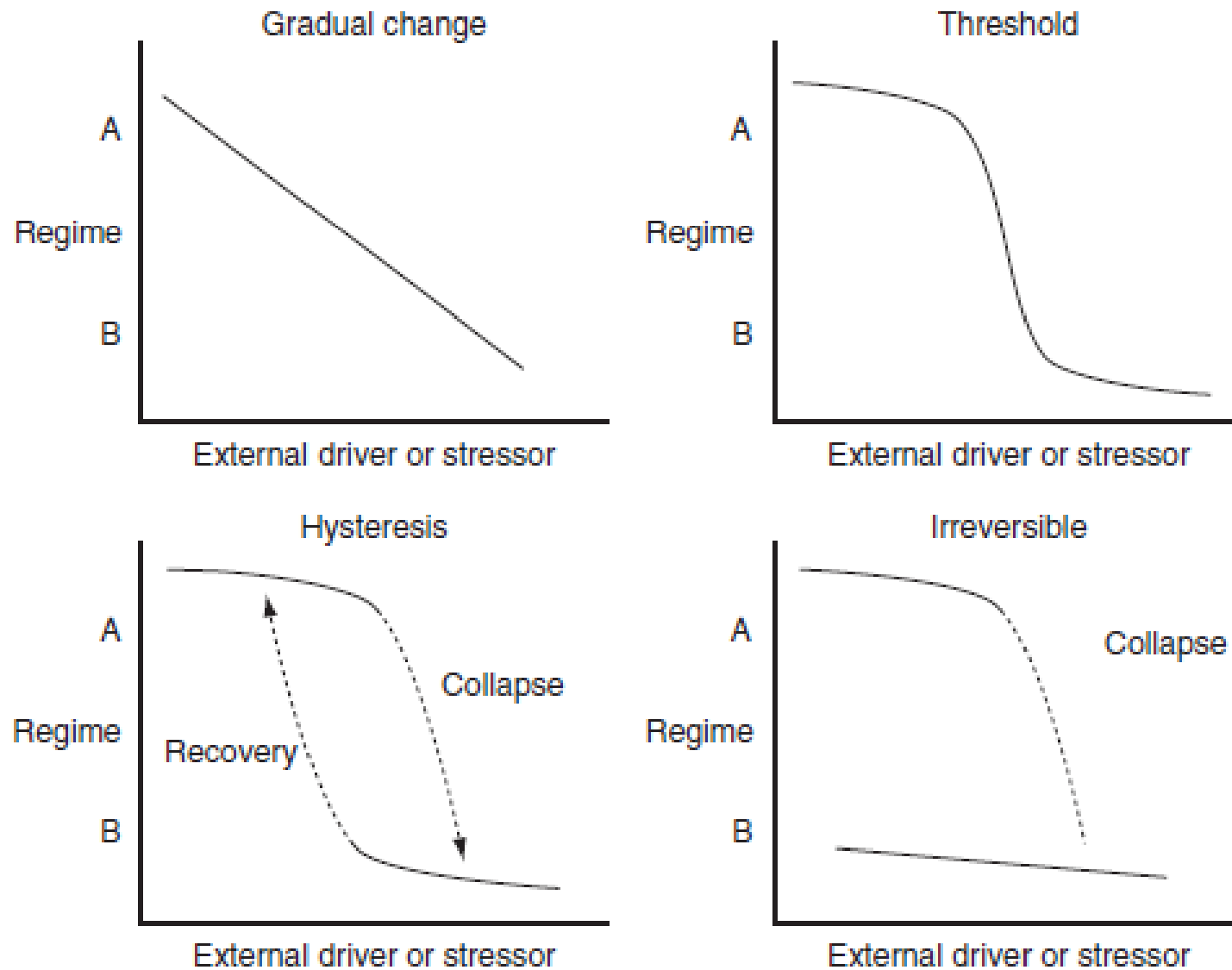
J. Davis et al 2010 – Multiple Stressors and Regime Shifts... Freshw. Biol.

Changes in Drivers



J. Davis et al 2010 – Multiple Stressors and Regime Shifts... Freshw. Biol.

Changes in Drivers



J. Davis et al 2010 – Multiple Stressors and Regime Shifts... Freshw. Biol.

Loss of **Ecological Resilience** Collapse, New Regime

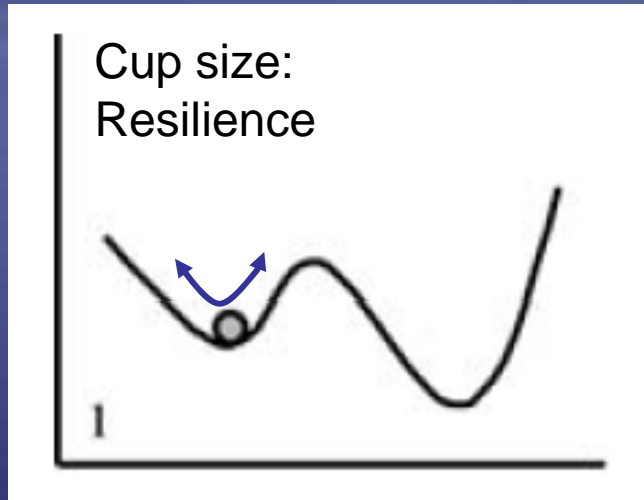


BDCP Reports Announcement, Nov 16, 2010:

...[Resources Secretary] Snow said, “our progress in developing the Bay Delta Conservation Plan speaks to a growing consensus that **we must achieve a Delta ecosystem that is more resilient** and improve the state’s water supply reliability.”

C. Folke et al 2004 – Regime shifts, resilience, and biodiversity in ecosystem management. Annu. Rev. Ecol. Evol. Syst

Loss of **Ecological Resilience** Collapse, New Regime



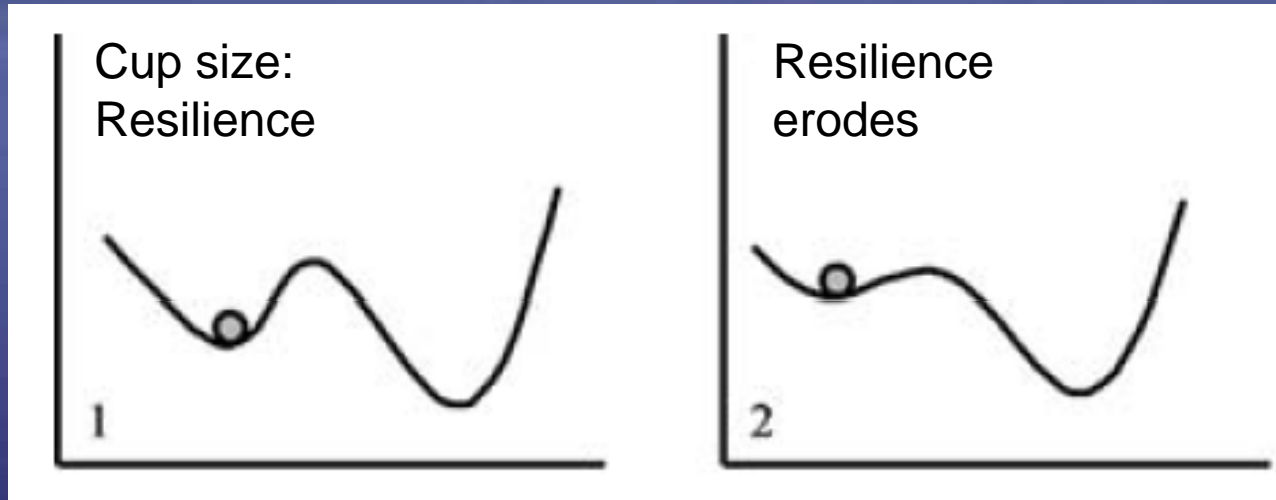
Cup = state of the system/drivers
Ball = state of the community

BDCP Reports Announcement, Nov 16, 2010:

...[Resources Secretary] Snow said, “our progress in developing the Bay Delta Conservation Plan speaks to a growing consensus that **we must achieve a Delta ecosystem that is more resilient** and improve the state’s water supply reliability.”

C. Folke et al 2004 – Regime shifts, resilience, and biodiversity in ecosystem management. Annu. Rev. Ecol. Evol. Syst

Loss of **Ecological Resilience** Collapse, New Regime

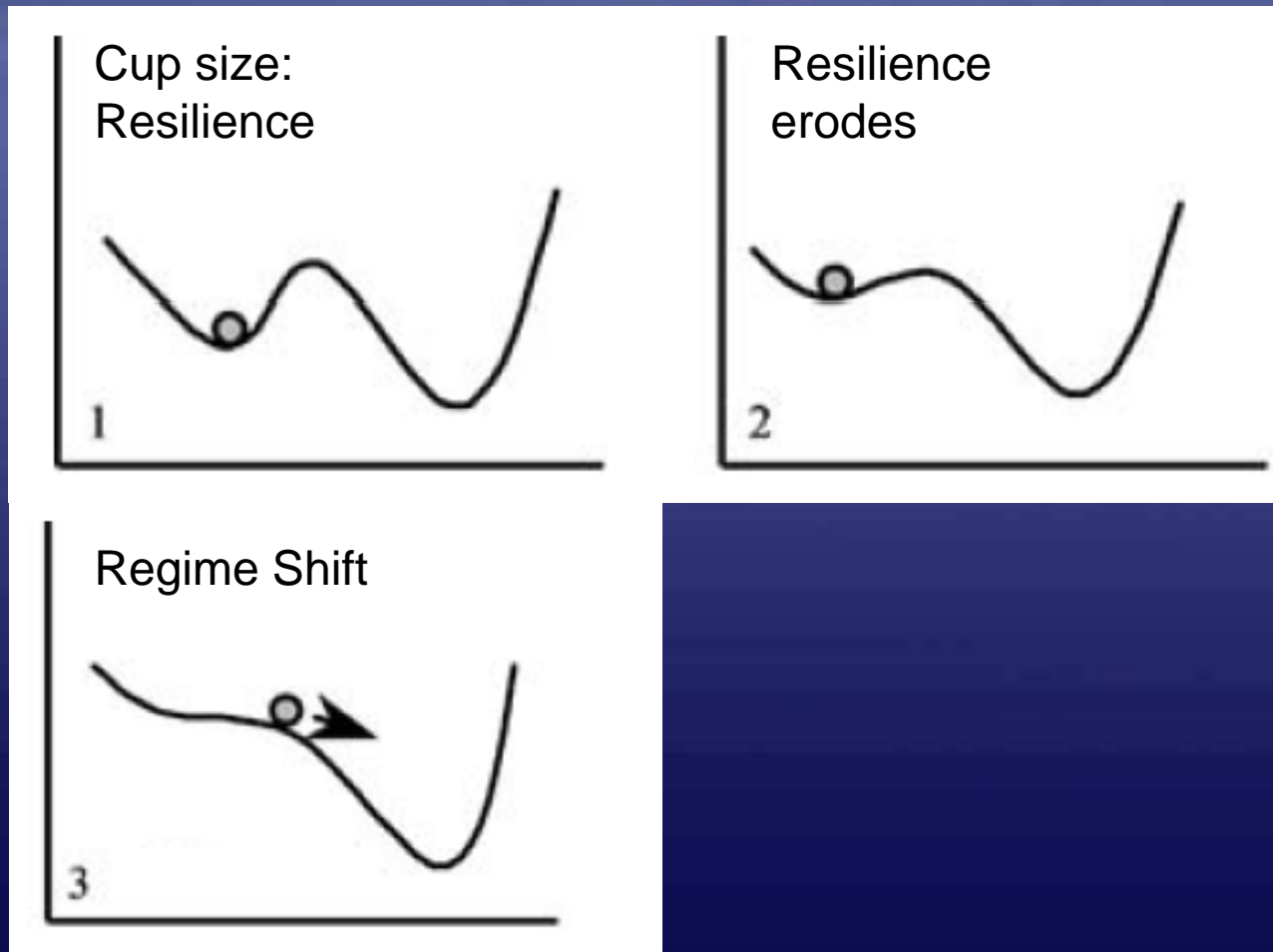


BDCP Reports Announcement, Nov 16, 2010:

...[Resources Secretary] Snow said, “our progress in developing the Bay Delta Conservation Plan speaks to a growing consensus that **we must achieve a Delta ecosystem that is more resilient** and improve the state’s water supply reliability.”

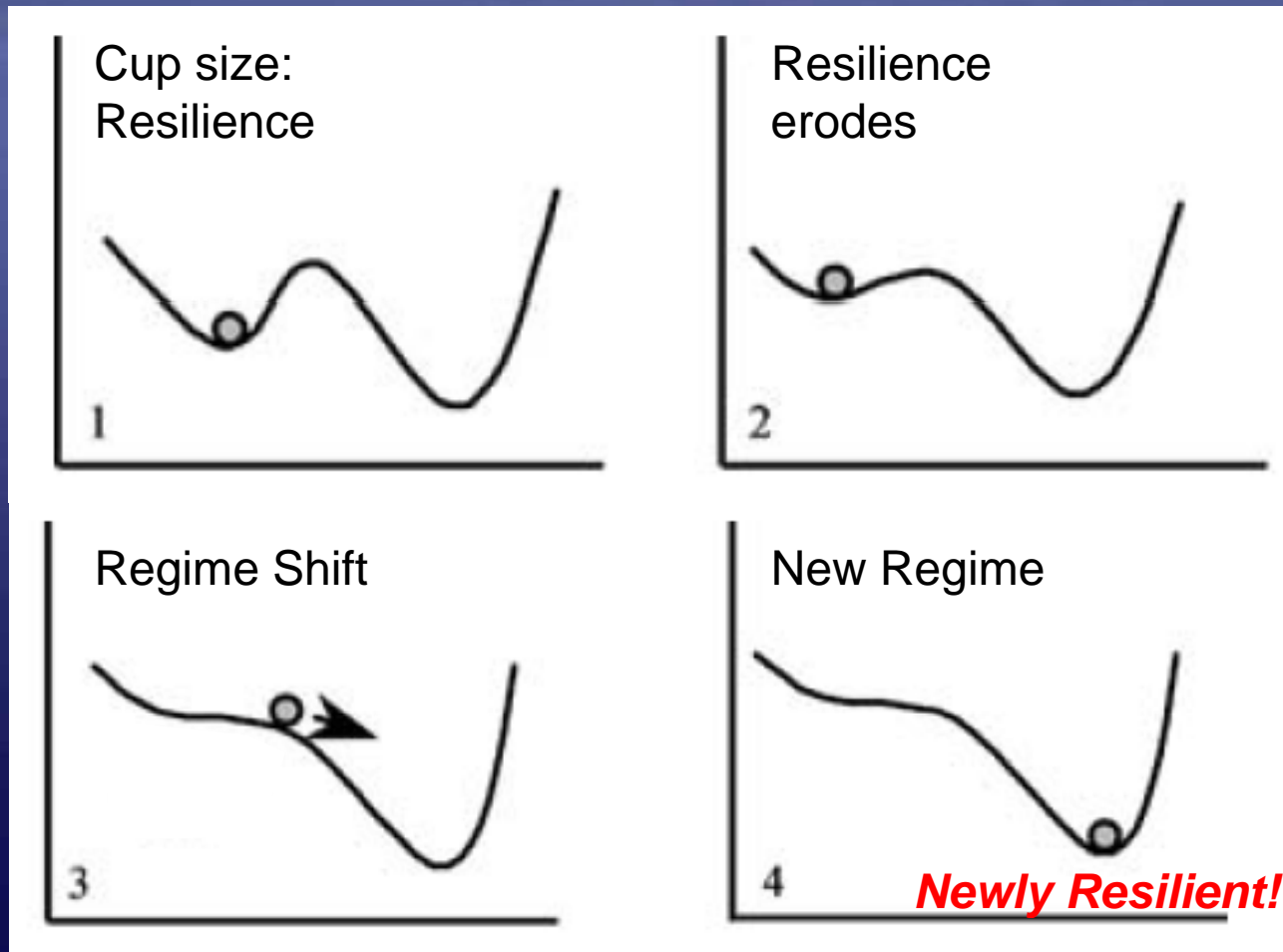
C. Folke et al 2004 – Regime shifts, resilience, and biodiversity in ecosystem management. Annu. Rev. Ecol. Evol. Syst

Loss of **Ecological Resilience** Collapse, New Regime



C. Folke et al 2004 – Regime shifts, resilience, and biodiversity in ecosystem management. Annu. Rev. Ecol. Evol. Syst

Loss of **Ecological Resilience** Collapse, New Regime



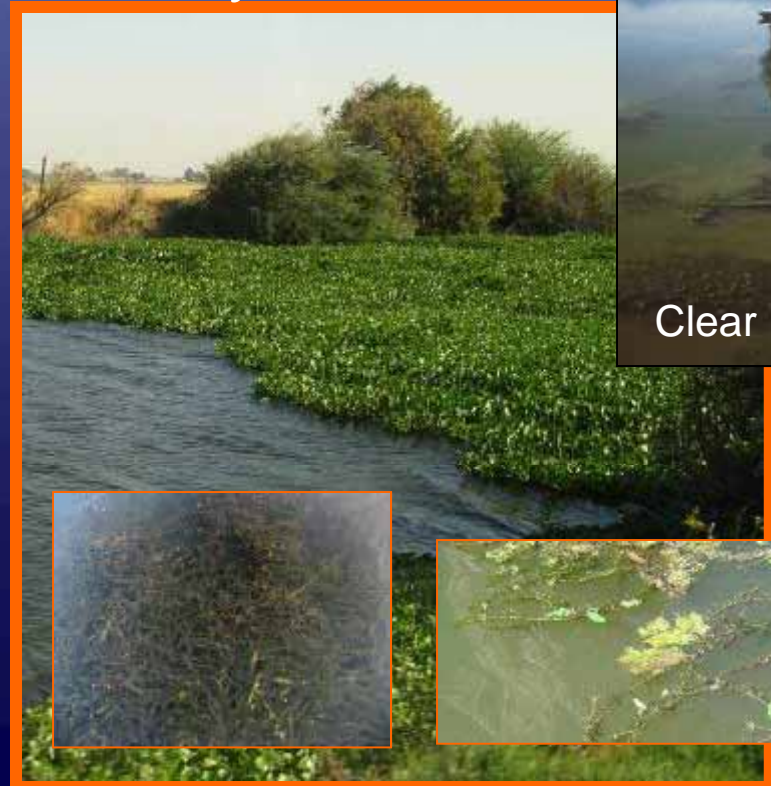
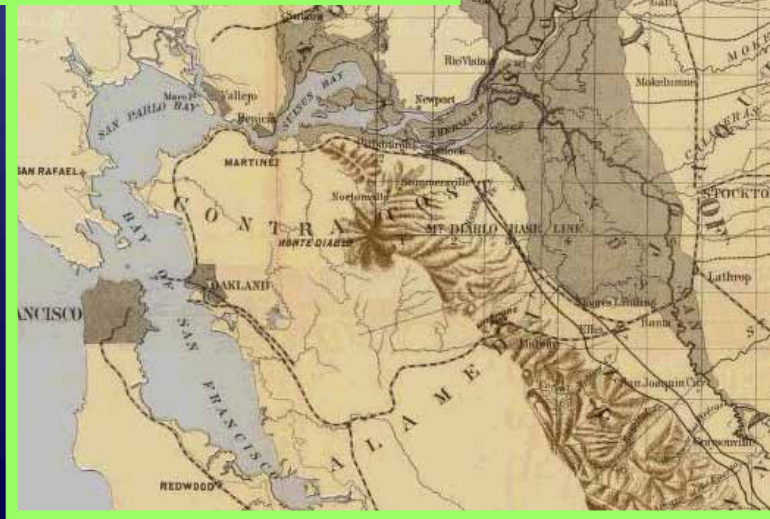
C. Folke et al 2004 – Regime shifts, resilience, and biodiversity in ecosystem management. Annu. Rev. Ecol. Evol. Syst

Ecological Regime Shift Story

From river estuary

... to “weedy lake”

1873 → Today

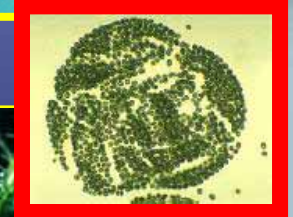
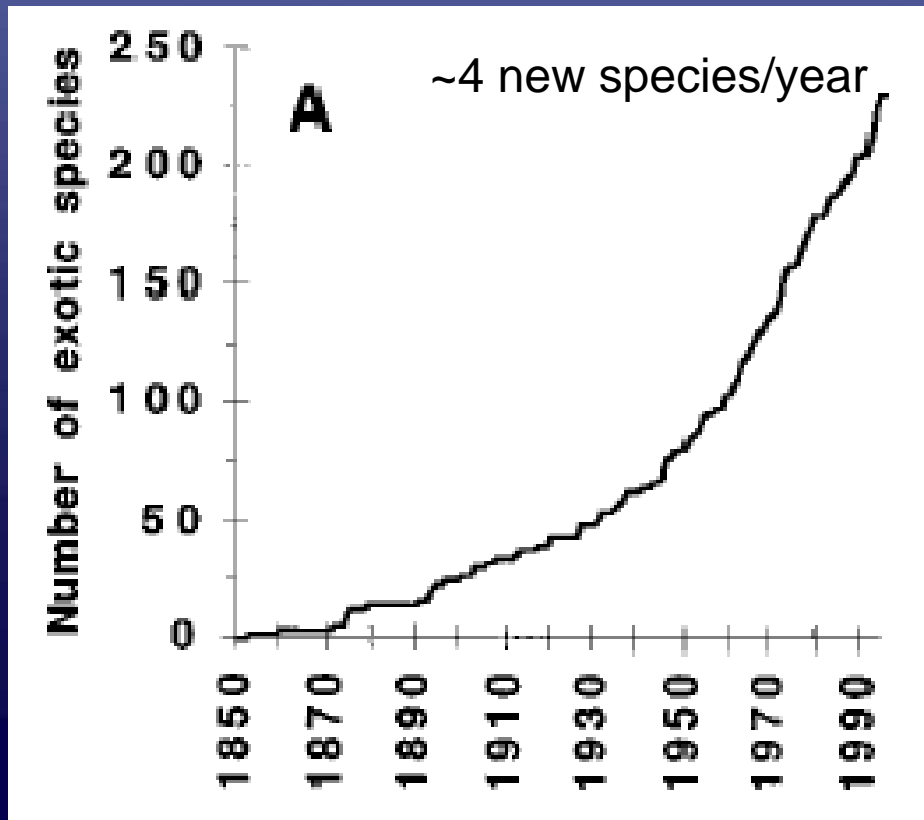


Clear Lake



Regime Shift Winners: Non-Native & Nuisance Species

“...the most invaded aquatic ecosystem in the world.”
(Cohen & Carlton, Science 1998)



Regime Shift Losers: Native Species, Unique Natural Heritage

Delta smelt



Listed since 1993

Longfin smelt



Listed since 2009

Green Sturgeon



Listed since 2006

Salmon



Listed since 1989(+)

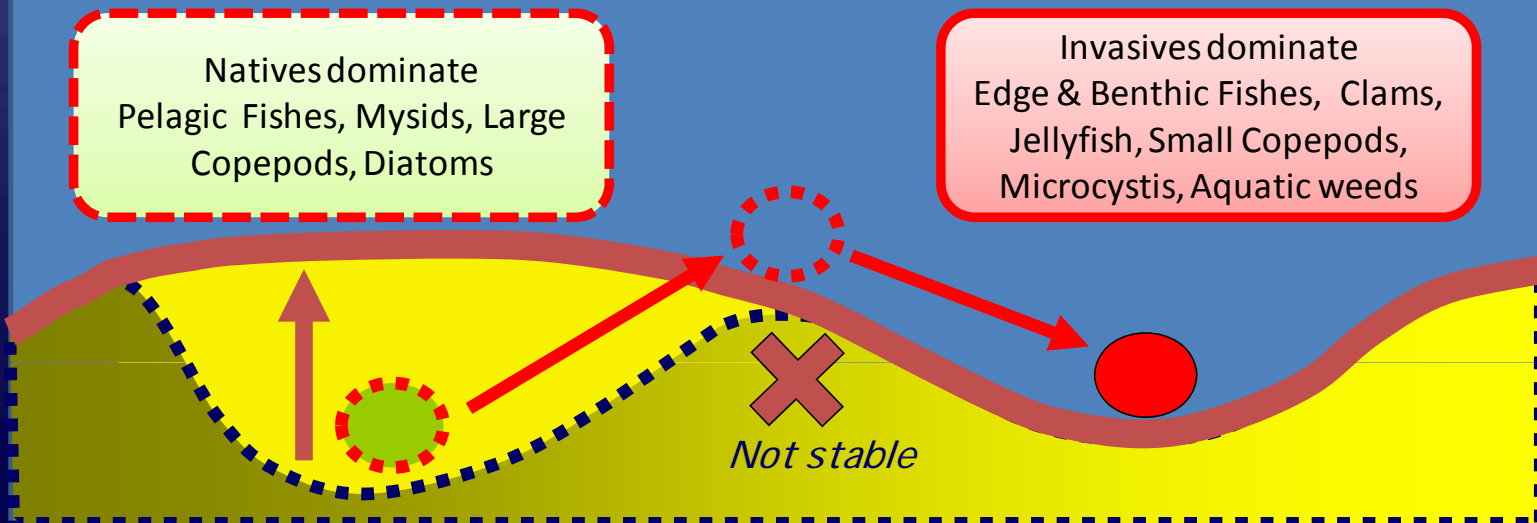
“Spatial fragmentation, homogenization, and loss of disturbance regimes ... favor small, easily dispersed species able to invade human-dominated ecosystems – the tramp species, colonizers, nitrogen-tolerant species, pests, and pathogens.”
David Western, PNAS 2001



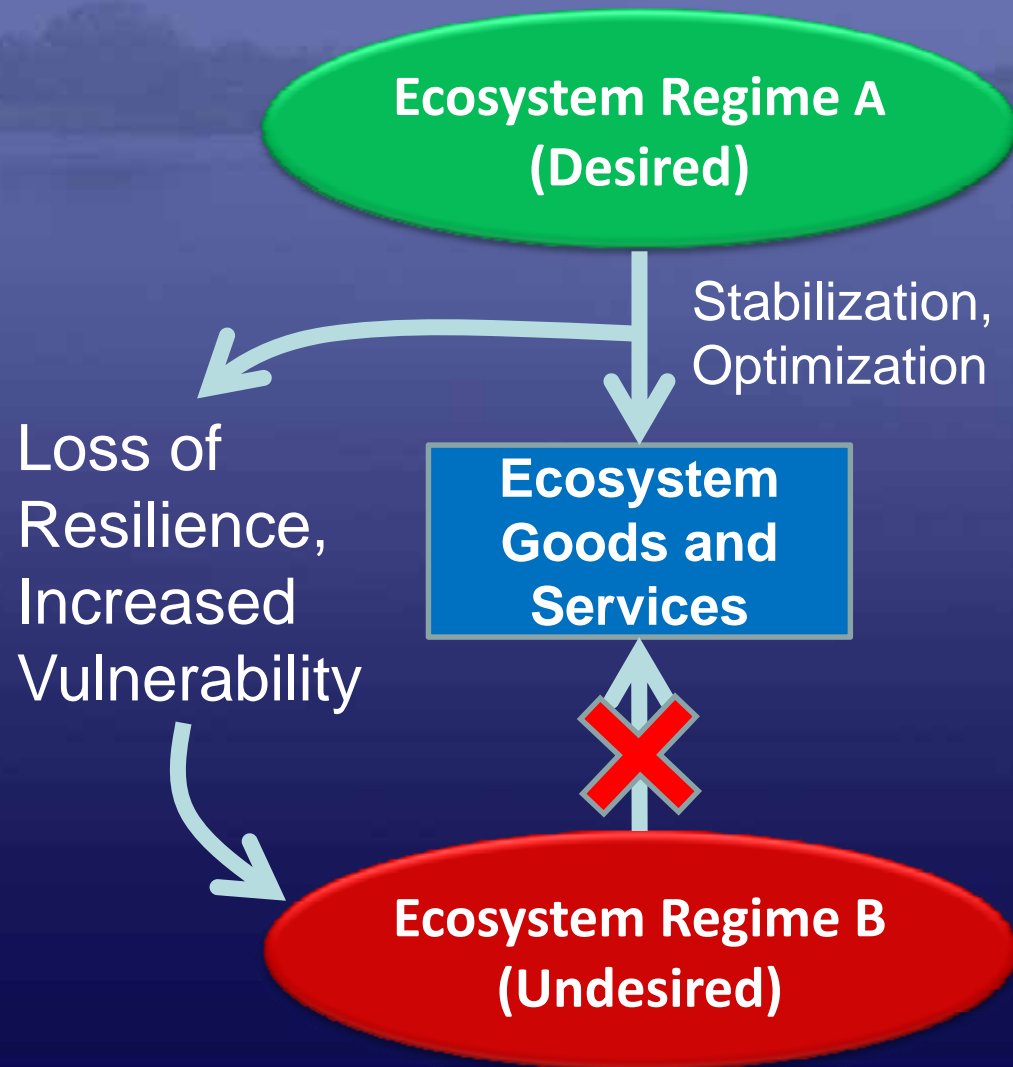
Resilience Drivers

**More Change
Will Come!**

Old Regime	Environmental Drivers	New Regime
<i>Variable, High</i>	Outflow	<i>Variable, Lower</i>
<i>To the west, Variable</i>	Salinity gradient	<i>To the east, Constricted</i>
<i>Complex, Variable</i>	Landscape	<i>Simplified, Rigid</i>
<i>Low, Variable</i>	Temperature	<i>High, Uniform</i>
<i>High, Variable</i>	Turbidity	<i>Low, Less variable</i>
<i>High P, low N</i>	Nutrients	<i>Low P, High N (NH₄⁺)</i>
<i>Few, Low</i>	Contaminants	<i>Many, High</i>
<i>Predation, Fishing</i>	"Harvest"	<i>Predation and Entrainment</i>



“Command and Control” Management Erosion of Resilience

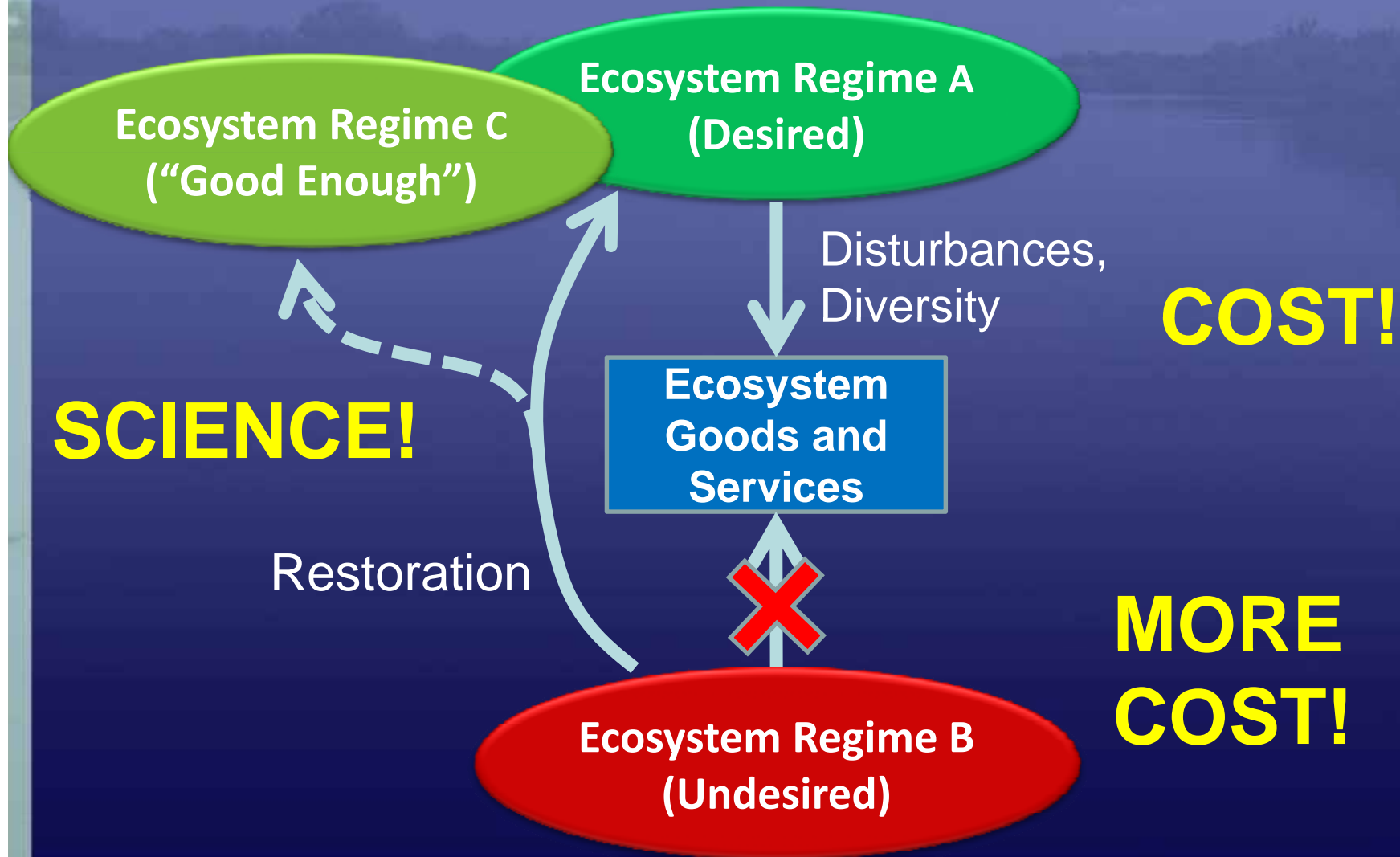


Folke et al. 2002

“Managing for Social-Ecological Resilience and Sustainability”

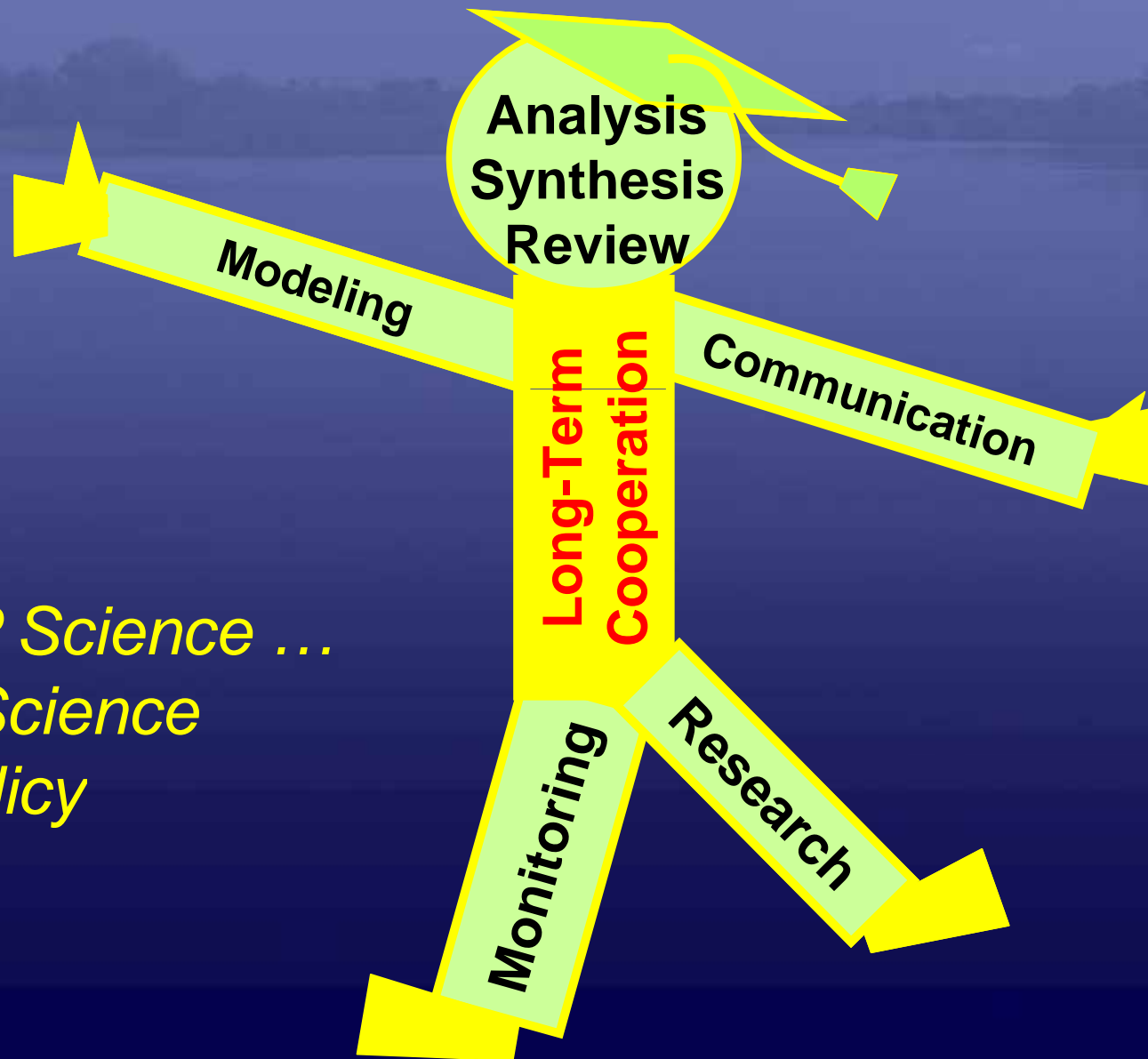
Adaptive Management

Sustain Resilience and Build Adaptive Capacity (Options)

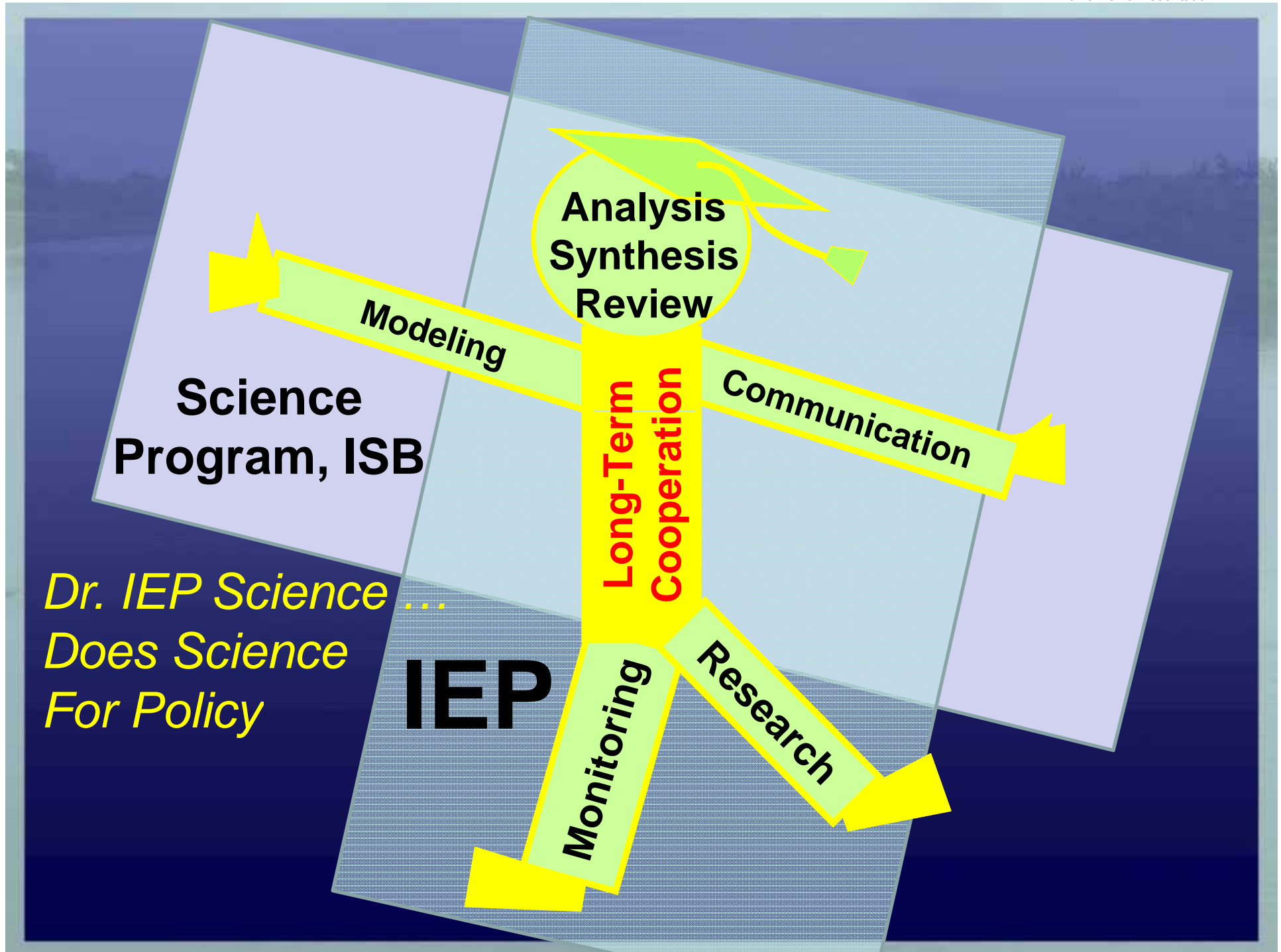


Folke et al. 2002

"Managing for Social-Ecological Resilience and Sustainability"



*Dr. IEP Science ...
Does Science
For Policy*



Adaptive Management

Sustain Resilience and Build Adaptive Capacity (Options)

It's not just the Delta...

Contaminants

Climate Change

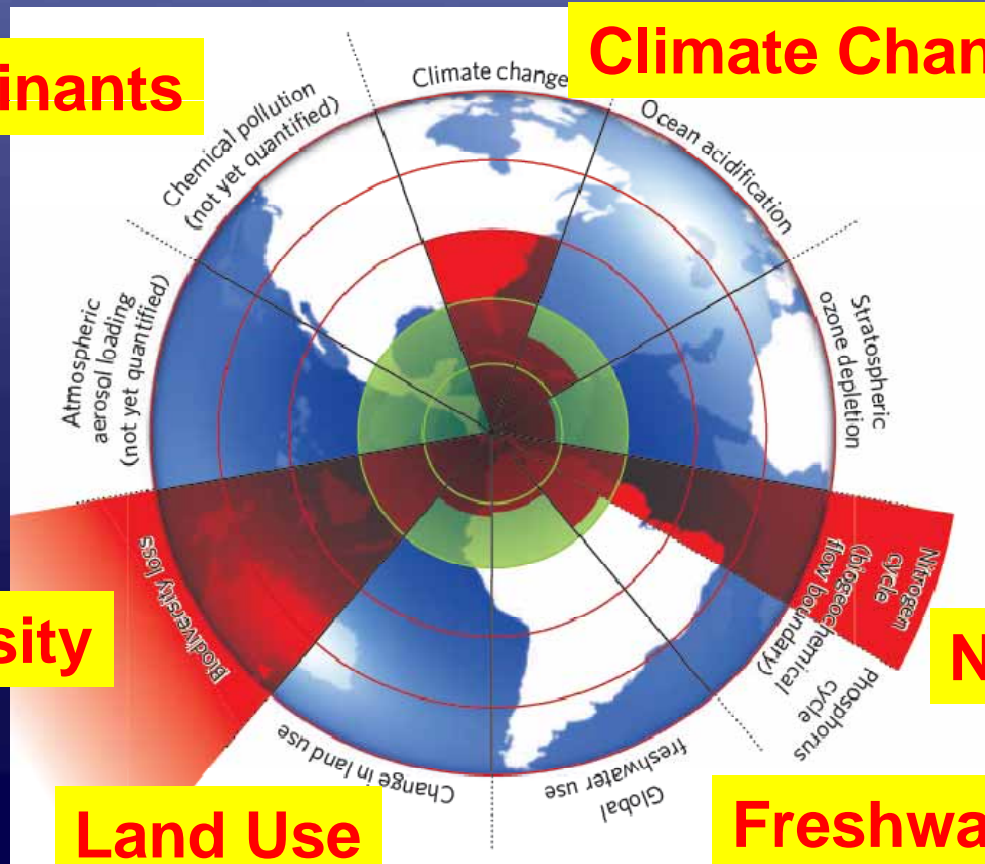
Rockström et al.
Nature 2009 –
Nine interlinked
“planetary boundaries”
keeping earth in
“desirable” state

Biodiversity

Nutrients

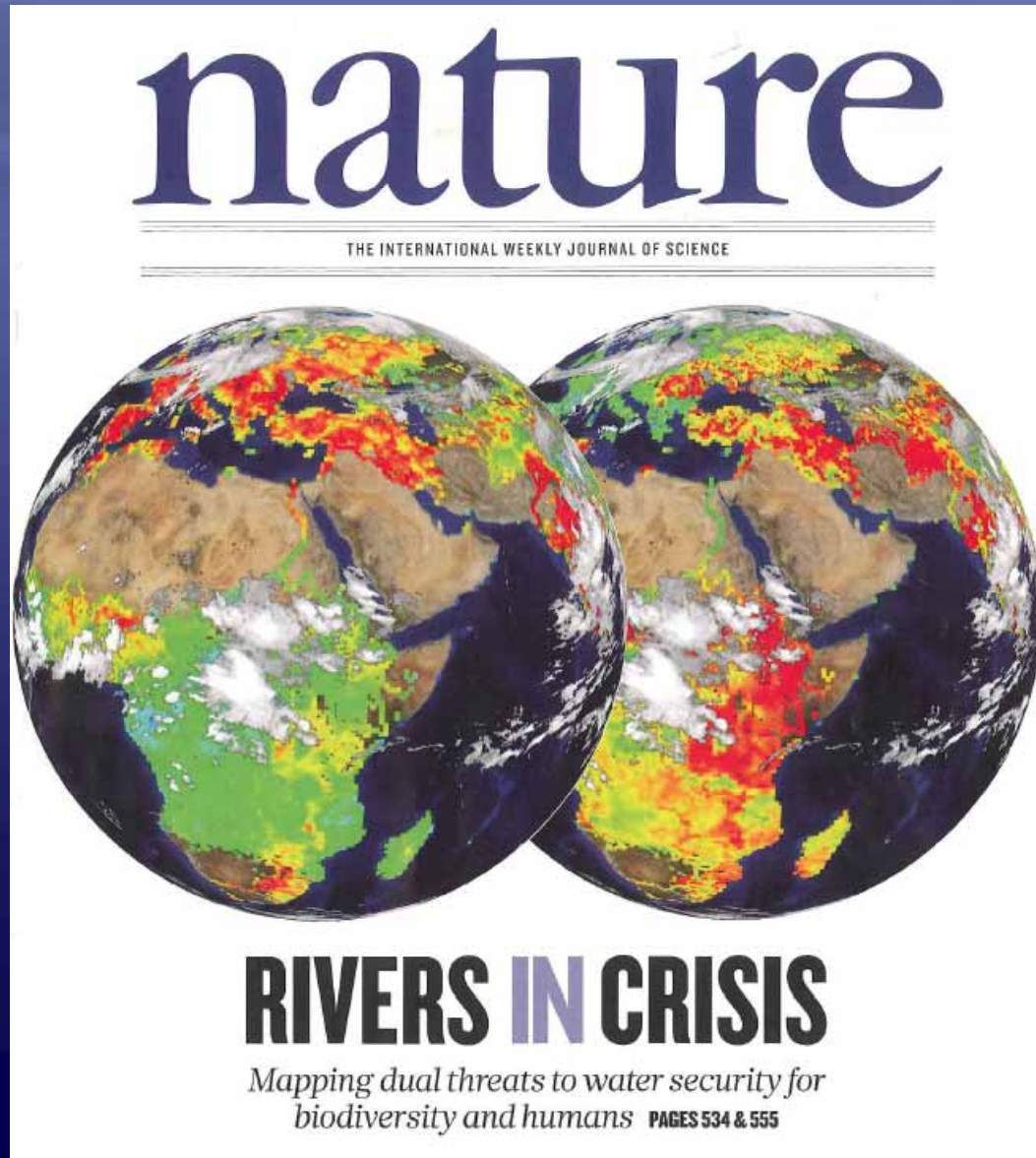
Land Use

Freshwater Use



Adaptive Management Sustain Resilience and Build Adaptive Capacity (Options)

River
Biodiversity



Human
Water
Security

30 Sep 2010

Adaptive Management Sustain Resilience and Build Adaptive Capacity

It's not just the Delta...

Problems not unique...

But the place (system) is unique.

Solutions have to fit the place.

Questions? Thanks!

“Planning for the future without a sense of history is like planting cut flowers.”

Daniel Boorstin

Historian and Librarian of Congress

amueller@deltacouncil.ca.gov